

CLAIMS

What is claimed is:

1 1. A method, comprising:

2 establishing a distribution pattern to distribute multilink frame relay (MFR)

3 fragments, the distribution pattern including a sequence of link entries

4 associated with links in a link bundle, wherein each link entry is identified

5 when the associated link is capable of transmitting a fragment in a fastest

6 transmit time, wherein the fastest transmit time is determined based on the

7 link speed of the link and a transmit time for the link to transmit other

8 fragments previously allocated to that link; and

9 distributing the fragments according to the distribution pattern from a first link entry

10 to a last link entry in the distribution pattern, wherein the distribution pattern is

11 repeated after the last link entry.

1 2. The method of claim 1, wherein a number of link entries in the distribution

2 pattern is determined by dividing a total link speed of the link bundle by a minimum

3 possible link speed supported by a system.

1 3. The method of claim 1, wherein the fastest transmit time is further determined

2 based on a fragment size.

1 4. The method of claim 3, wherein when more than one link is capable of
2 transmitting a fragment in a fastest transmit time, the link entry is identified based
3 on an associated link having a fastest link speed.

1 5. The method of claim 1, wherein the transmit time for the link to transmit other
2 fragments previously allocated to that link is accumulative until the last link entry in
3 the distribution pattern is determined.

1 6. The method of claim 1, wherein distributing the fragments according to the
2 distribution pattern comprises:

3 selecting a link entry from the distribution pattern in the sequence from the
4 first link entry to the last link entry;
5 determining if a link associated with the selected link entry has available
6 credit;
7 when the link has available credit, distributing the fragment to the link and
8 reducing the credit available to that link; and
9 when the link does not have available credit, selecting a next link entry in
10 the sequence.

1 7. The method of claim 6, wherein the credit is allocated to each link based on
2 the link speed and a periodic interval gap.

1 8. The method of claim 6, wherein the distribution pattern is repeated at the first
2 link entry and before selecting the last link entry, after expiration of a

3 predetermined waiting time period to receive a fragment to be distributed to a link
4 in the link bundle.

1 9. The method of claim 1, wherein the distribution pattern is implemented as an
2 array data structure.

1 10. A method, comprising:
2 determining a number of positions in a distribution pattern;
3 identifying a link entry for a first position in the distribution pattern, comprising:
4 selecting a link in the link bundle that is capable of transmitting a
5 first fragment in a fastest time based on the link speed of each link, a total
6 transmit time associated with each link, and a fragment size;
7 placing a link entry associated with the selected link in the first position in the
8 distribution pattern;
9 adding the fastest transmit time to the total transmit time associated with the
10 selected link; and
11 repeating said identifying for a link entry for a next position in the distribution
12 pattern to transmit a next fragment until a link entry is selected for all positions
13 in the distribution pattern.

1 11. The method of claim 10, wherein the number of positions in the distribution
2 pattern is based on a total link speed of links in a link bundle and a minimum
3 possible link speed of a link supported by a system.

1 12. The method of claim 10, wherein when there is more than one link having the
2 same fastest transmit time, a link associated with a fastest link speed is selected.

1 13. The method of claim 10, further comprising distributing fragments according to
2 the distribution pattern from the link entry in the first position to a link entry in a last
3 position in the distribution pattern, wherein the distribution pattern is repeated after
4 the link entry in the last position.

1 14. The method of claim 13, wherein distributing the fragments according to the
2 distribution pattern comprises:

3 selecting a link entry from the distribution pattern in a sequence from the
4 first position to the last position;

5 determining if a link associated with the selected link entry has available
6 credit;

7 when the link has available credit, distributing a current fragment to the link
8 and reducing the available credit for that link; and

9 when the link does not have available credit, selecting a next link entry in
10 the sequence.

1 15. The method of claim 14, wherein the credit is allocated to each link based on
2 the link speed and a periodic interval gap.

1 16. A computer readable medium having stored thereon sequences of instructions
 2 which are executable by a system, and which, when executed by the system,
 3 cause the system to:

4 establish a distribution pattern to distribute multilink frame relay (MFR)
 5 fragments, the distribution pattern including a sequence of link entries associated
 6 with links in a link bundle, wherein each link entry is placed in the distribution
 7 pattern when the link is capable of transmitting a fragment in a fastest transmit
 8 time, the fastest transmit time determined based on the link speed of the link and a
 9 transmit time for the link to transmit other fragments previously allocated to the
 10 link; and

11 distribute the fragments according to the distribution pattern from a first link
 12 entry to a last link entry in the distribution pattern, wherein the distribution pattern
 13 is repeated after the last link entry.

1 17. The computer readable medium of claim 16, wherein the number of link entries
 2 in the distribution pattern is determined by dividing a total link speed of the link
 3 bundle by a minimum possible link speed supported by a system.

1 18. The computer readable medium of claim 16, wherein the fastest transmit time
 2 is further determined based on a fragment size.

1 19. The computer readable medium of claim 16, wherein when more than one link
2 is capable of transmitting a fragment in a fastest transmit time, the link entry is
3 determined based on an associated link having a fastest link speed.

1 20. The computer readable medium of claim 16, wherein the transmit time for the
2 link to transmit other fragments previously allocated to that link is accumulative
3 until the last link entry in the distribution pattern is determined.

1 21. The computer readable medium of claim 16, wherein the instructions to
2 distribute the fragments according to the distribution pattern comprises instructions
3 to:

4 select a link entry from the distribution pattern in the sequence from the

5 first link entry to the last link entry;

6 determine if a link associated with the selected link entry has available

7 credit;

8 when the link has available credit, distribute the fragment to the link and

9 reduce the credit available to that link; and

10 when the link does not have available credit, select a next link entry in the

11 sequence.

1 22. The computer readable medium of claim 21, wherein the credit is allocated to
2 each link based on the link speed and the periodic interval gap.

1 23. The computer readable medium of claim 16, wherein the distribution pattern is
 2 repeated at the first link entry and before selecting the last link entry after
 3 expiration of a predetermined waiting time period to receive a fragment to be
 4 distributed to a link in the link bundle.

1 24. The computer readable medium of claim 16, wherein the distribution pattern is
 2 implemented as an array data structure.

1 25. A computer readable medium having stored thereon sequences of instructions
 2 which are executable by a system, and which, when executed by the system,
 3 cause the system to:

4 determine a number of positions in a distribution pattern;

5 identify a link entry for a first position in the distribution pattern, comprising
 6 instructions to:

7 select a link in the link bundle that is capable of transmitting a first fragment

8 in a fastest time based on the link speed of each link, a total transmit

9 time associated with each link, and a fragment size;

10 place a link entry associated with the selected link in the first position in the

11 distribution pattern; and

12 add the fastest transmit time to the total transmit time associated with the

13 selected link; and

14 repeat said instructions to identify for a link entry for a next position in the

15 distribution pattern to transmit a next fragment until a link entry is

16 selected for all positions in the distribution pattern.

1 26. The computer readable medium of claim 25, wherein the number of positions
2 in the distribution pattern is based on a total link speed of links in a link bundle and
3 a minimum possible link speed supported by a system.

1 27. The computer readable medium of claim 25, wherein when there is more than
2 one link having the same fastest transmit time, a link associated with a fastest link
3 speed is selected.

1 28. The computer readable medium of claim 25, further comprising instructions to
2 distribute fragments according to the distribution pattern from the link entry in the
3 first position to a link entry in a last position in the distribution pattern, wherein the
4 distribution pattern is repeated after the link entry in the last position.

1 29. The computer readable medium of claim 28, wherein the instructions to
2 distribute the fragments according to the distribution pattern comprises instructions
3 to:

4 select a link entry from the distribution pattern in a sequence from the
5 first position to the last position;

6 determine if a link associated with the selected link entry has available
7 credit;

8 when the link has available credit, distribute a current fragment to the link

9 and reduce the credit available to that link; and
 10 when the link does not have available credit, select a next link entry in
 11 the sequence.

1 30. The computer readable medium of claim 29, wherein the credit is allocated to
 2 each link based on the link speed.

1 31. A system, comprising:
 2 a memory;
 3 a processor configured to establish a distribution pattern to distribute multilink
 4 frame relay (MFR) fragments, the distribution pattern including a sequence of
 5 link entries associated with links in a link bundle, wherein each link entry is
 6 placed in the distribution pattern when the link is capable of transmitting a
 7 current fragment in a fastest transmit time, wherein the fastest transmit time is
 8 determined based on the link speed of the link and a transmit time for the link
 9 to transmit other fragments previously allocated to the link.

1 32. The system of claim 31, wherein the processor is further configured to
 2 distribute the fragments according to the distribution pattern from a first link entry
 3 to a last link entry in the distribution pattern, wherein the distribution pattern is
 4 repeated after the last link entry.

10 the sequence.

1 38. The system of claim 37, wherein the credit is allocated to each link based on
2 the link speed and a periodic interval gap.

1 39. The system of claim 31, wherein the distribution pattern is repeated at the first
2 link entry and before selecting the last link entry after expiration of a
3 predetermined waiting time period to receive a fragment to be distributed to a link
4 in the link bundle.

1 40. The system of claim 31, wherein the distribution pattern is implemented as an
2 array data structure.

1 41. A system, comprising:
2 means for establishing a distribution pattern to distribute multilink frame relay
3 (MFR) fragments, the distribution pattern including a sequence of link entries
4 associated with links in a link bundle; and
5 means for distributing the fragments according to the distribution pattern from
6 a first link entry to a last link entry in the distribution pattern, wherein the
7 distribution pattern is repeated after the last link entry.

1 42. The system of claim 41, wherein the means for distributing the fragments
2 according to the distribution pattern comprises means for selecting a link entry
3 from the distribution pattern based on available credit.

1 43. The system of claim 41, wherein the means for distributing the fragments
2 according to the distribution pattern comprises means detecting expiration of a
3 predetermined waiting period and means for resetting to the first entry in the
4 distribution pattern.

1 44. A method, comprising:
2 establishing a distribution pattern to distribute multilink frame relay (MFR)
3 fragments, the distribution pattern including a sequence of link entries
4 associated with links in a link bundle; and
5 distributing the fragments according to the distribution pattern from a first link entry
6 to a last link entry in the distribution pattern, wherein the distribution pattern is
7 repeated after the last link entry.

1 45. The method of claim 44, wherein a number of link entries in the distribution
2 pattern is determined by dividing a total link speed of the link bundle by a minimum
3 possible link speed supported by a system.

1 46. The method of claim 44, wherein each link entry in the distribution pattern is
2 determined based on the associated link being able to transmit a fragment in a
3 fastest transmit time, the fastest transmit time determined based on the link speed
4 of the link, a fragment size, and a transmit time for the link to transmit other
5 fragments previously allocated to that link.

1 47. The method of claim 46, wherein when more than one link is capable of
2 transmitting a fragment in the fastest transmit time, the link entry is determined
3 based on an associated link having a fastest link speed.

1 48. The method of claim 44, wherein the transmit time for the link to transmit other
2 fragments previously allocated to that link is accumulative until the last link entry in
3 the distribution pattern is determined.

1 49. The method of claim 44, wherein the fragments are further distributed based
2 on available credit.

1 50. An apparatus, comprising:
2 a link bundle including two or more links, the link bundle configured to transmit
3 multilink frame relay (MFR) fragments according to a distribution pattern, wherein
4 the distribution pattern comprises link entries associated with each of the two or
5 more links in the link bundle.

1 51. The apparatus of claim 50, wherein a number of entries in the distribution
2 pattern is determined by dividing a total speed of the links in the link bundle by a
3 minimum possible link speed supported by a system.

1 52. The apparatus of claim 50, wherein the distribution pattern is repeated after a
2 last link entry.

1 53. The apparatus of claim 50, wherein each link entry in the distribution pattern is
2 identified based on a link speed of a link and a transmit time for the link to transmit
3 other fragments previously allocated to that link.

1 54. An apparatus, comprising:
2 means for transmitting multilink frame relay (MFR) fragments according to a
3 distribution pattern, wherein the distribution pattern comprises link entries
4 associated with links in a link bundle.

1 55. The apparatus of claim 54, further comprising means for determining a
2 number of entries in the distribution pattern.

1 56. The apparatus of claim 54, further comprising means for identifying each link
2 entry in the distribution pattern.